



CDR IN OPERATIONS

PATMOS-x AVHRR CDR

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PATMOS-x Description

- Pathfinder Atmospheres Extended (PATMOS-x) is a NESDIS AVHRR climate data set with cloud, surface and radiometric data records.
- Primary product is 0.1x0.1 degree 2x daily global fields for each sensor. Data is sampled from full-resolution Level-1b/Level-2, not averaged. Similar in philosophy to ISCCP/GridSat – not just a CDR in itself, but designed to be useful for product generation.
- SDS/CDR program funded a recalibration of the entire record of AVHRR solar reflectance channels tied to MODIS (C5)
- PATMOS-x v5.2 data delivered to NCDC in 2010 (1978-2009)
- PATMOS-x v5.3 data will be redelivered later this year (1978-2012).
- PATMOS-x v6.x solar reflectance calibration will be tied to Collection 6 MODIS data.

PATMOS-x Production

- PATMOS-x code base is same as AVHRR code running in NESDIS Office of Satellite Processing and Operation (OSPO). For CDR, we use non real-time ancillary data (NCEP CFSR, OISSTv2, GLOBSNOW (?)).
- These data are available within a few days of real-time and allow for a **preliminary CDR generation** with extrapolated solar reflectance calibration.
- IR calibration still follows the “1990’s Pathfinder” approach enhanced with some additional calibration slope/intercept filtering.
- Navigation is modified when clock corrections are known. (Fred Nagle/SSEC)
- At CIMSS, we generate CDR’s daily with a time lag of a few days and will provide daily updates to NCDC and make monthly anomalies.
- After every annual calibration update, we reprocess all impacted sensors and redeliver the final CDR data.
- About one month to reprocess from Level-1b to Level-2b using CIMSS cluster.

Product Delivery Description

CDR(s)	Period of Record	Temporal Resolution	Update Frequency	Update Lag	Spatial Resolution	Data file distinction criteria	Do you publicly serve the CDR at your institution?
0.63, 0.86 μm TOA Reflectance	1978-present	2x daily per sensor.	Calibration is updated annually.	We expect our daily updates to lag no more than one week from real-time.	Data points have a nadir resolution of 4 km and are spaced 10 km apart.	Data files are defined by sensor, day of observation and orbital node (asc/des)	We serve regional (smaller) datasets at CIMSS and serve PATMOS-x applied to other sensors (GOES, MODIS). We don't have space for entire PATMOS-x GAC CDR.
1.6 μm TOA Refl.	2002-12	This means temporal resolution varied from 2x to 8x daily.	Preliminary CDRs are generated daily				
3.75, 11, 12 μm BT	1978-2012		updated annually with FCDRS				
Cloud Mask	1978-2012						
Cloud Products	1982-2012						

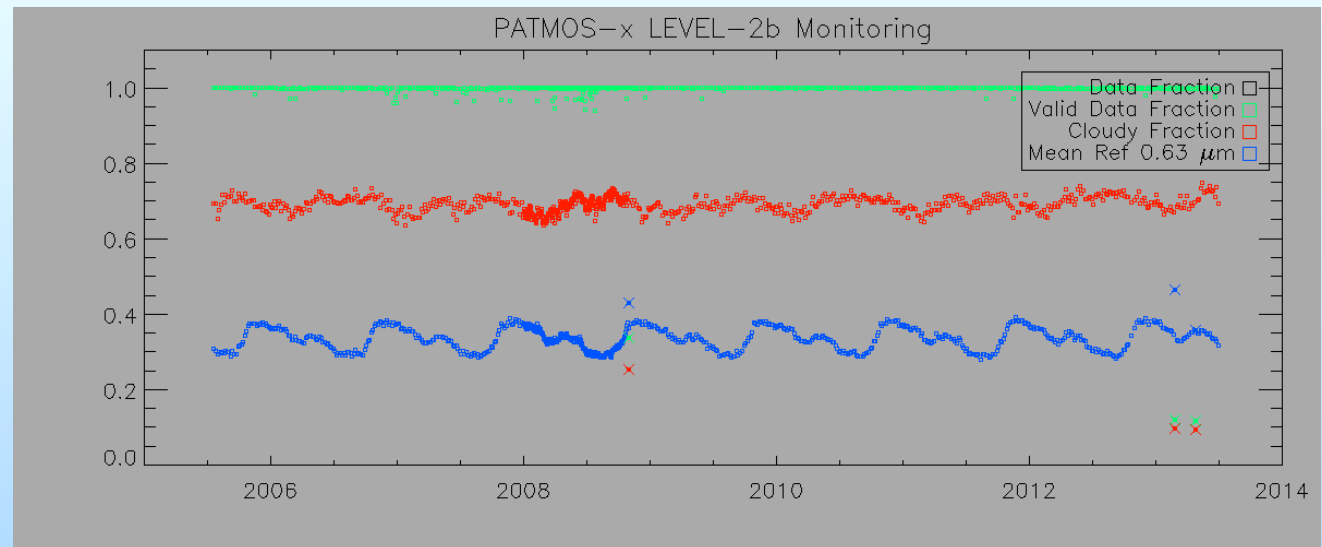
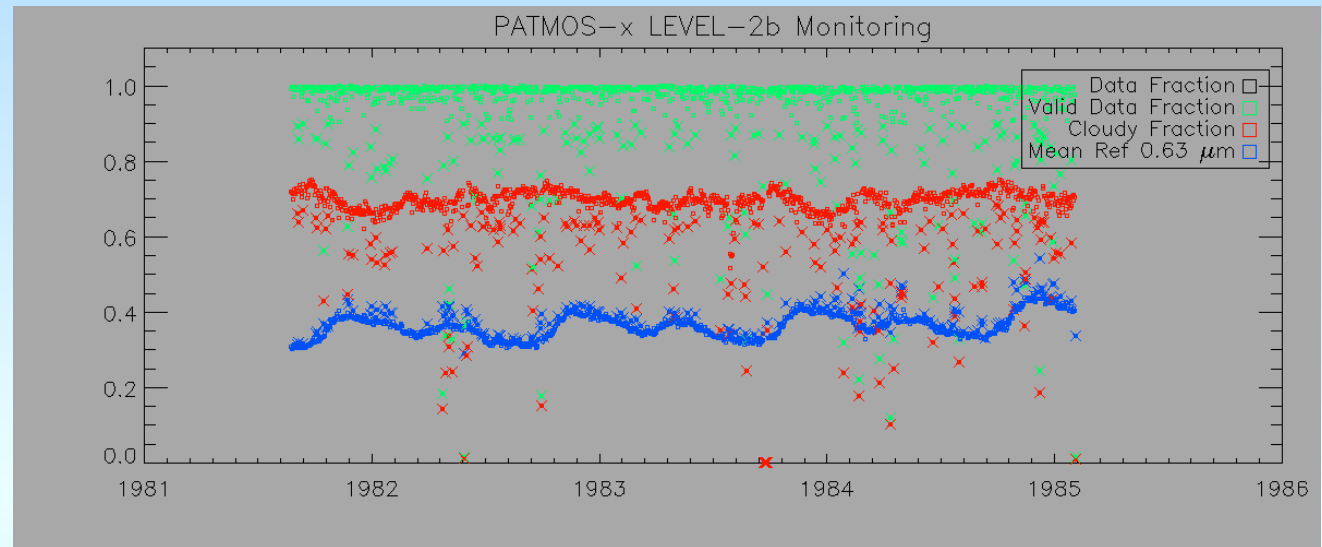
- Collateral products include quality flags, ancillary data and selected diagnostic fields.

Validation & Quality Assurance

- PATMOS-x Level-2b data **amended to include attributes** that contain mean values of FCDRs (calibrated observations), fraction of valid data and cloud fraction.
- These are monitored every day. Daily values compared to long-term annual cycles for that sensor.
- Long-term cloud product time series extended every month and analyzed for inter-satellite consistency.
- Long term cloud product time series compared to analogous records from other sensors and reanalysis data. (analogous to GEWEX cloud assessment)

PATMOS-x Daily Quality Monitoring

- PATMOS-x now includes metadata attributes that can be used to assess quality of the data.
- Images on right show relative quality in NOAA-7 (1981-1985) and NOAA-18 (2005-2013).
- Fraction of data coverage much less for NOAA-6,8,10 and TIROS-N.



FCDR Monitoring ($0.63 \mu\text{m}$)

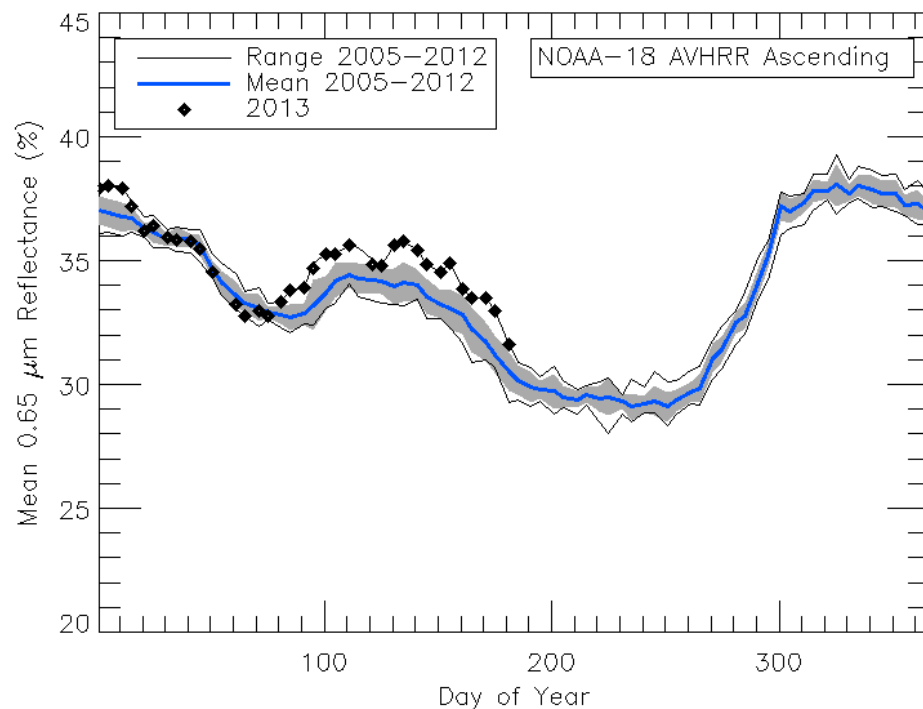
We process global AVHRR GAC data everyday and store mean values of FCDR (Calibrated Channel Observations). Data is from CLASS. Time lag is one day.

Images below show one day of observations (left) and the mean annual cycle (left). The blue line is the annual mean. The grey zone is the mean \pm one standard deviation. The symbols are the global means for one day of 2012. This data is for the ascending nodes of NOAA-18 (2005-2012). (Every 5th day shown for clarity).

patmosx_noda-18_asc_2008_160.level2b



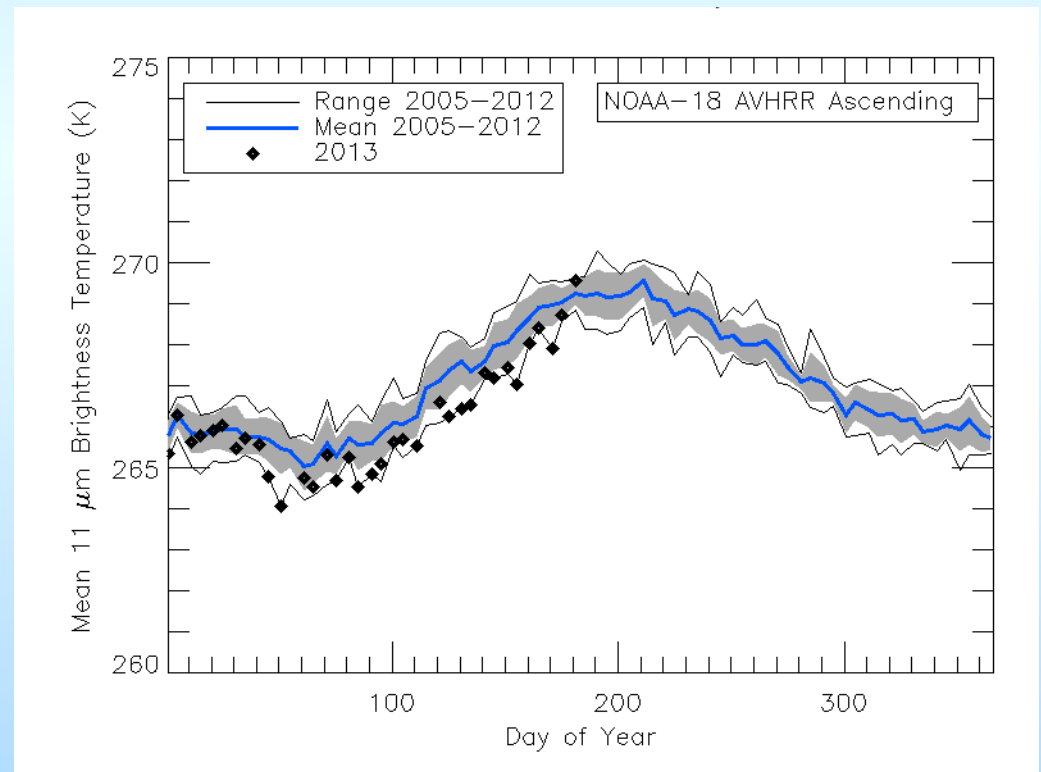
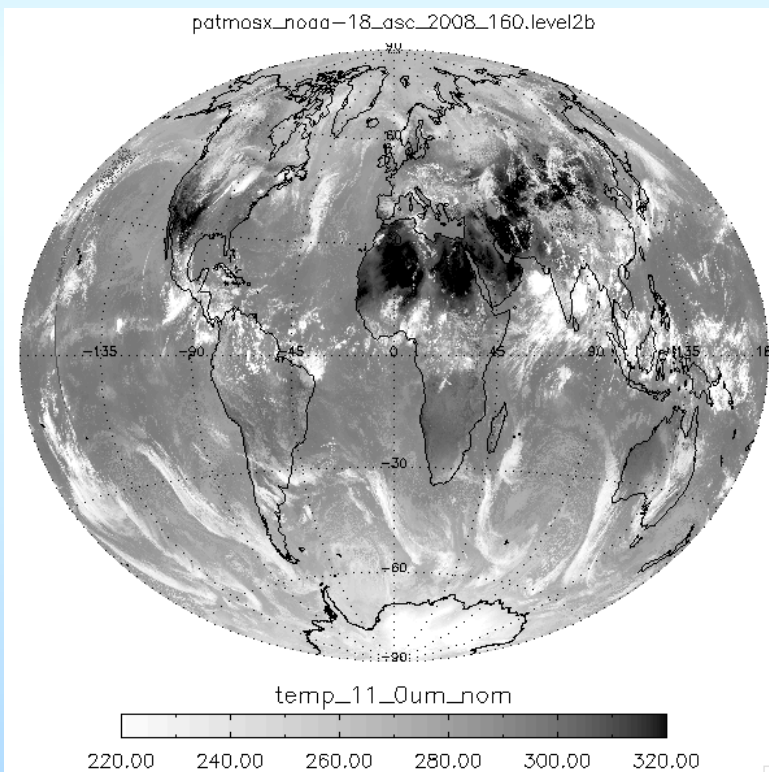
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FCDR Monitoring ($11\ \mu\text{m}$)

We process global AVHRR GAC data everyday and store mean values of FCDR (Calibrated Channel Observations).

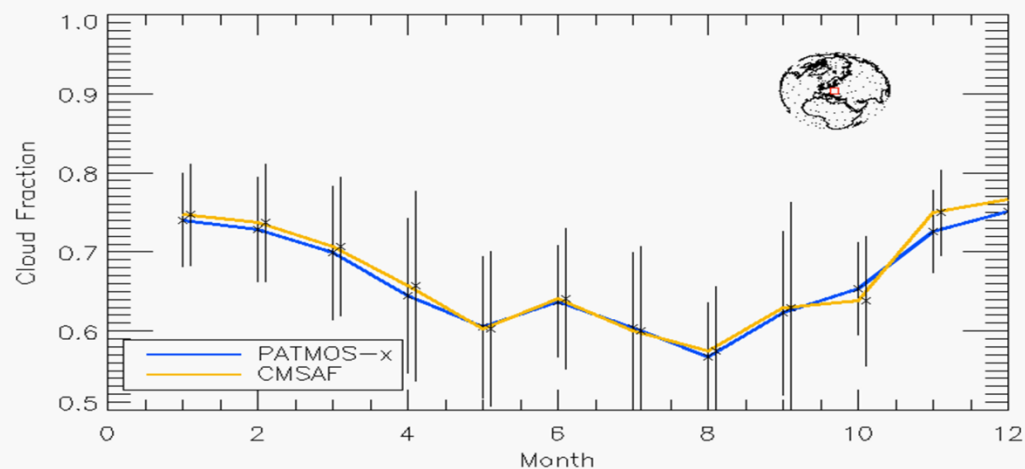
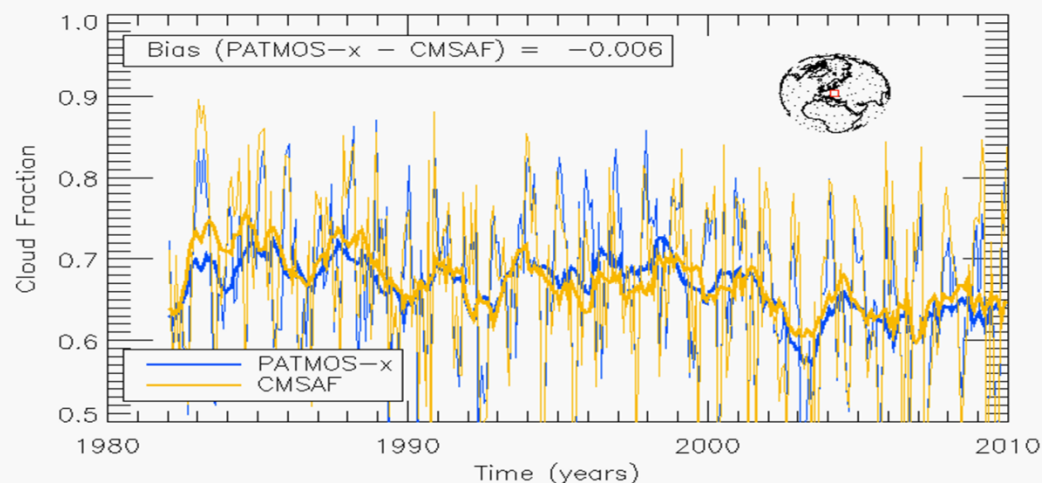
Images below show one day of observations (left) and the mean annual cycle (right). The blue line is the annual mean. The grey zone is the mean \pm one standard deviation. The symbols are the global means for one day of 2012. This data is for the ascending nodes of NOAA-18 (2005-2012). (Every 5th day shown for clarity).



COMPARISON TO CM-SAF CLARA-1

- EUMETSAT CM-SAF AVHRR Cloud (CLARA) Data Set released in 2012.
- Uses PATMOS-x solar calibration and same thermal calibration and geolocation techniques.
- Use same CLASS Level-1b data.
- We are exploring consistency in time-series (SCOPE-CM).
- We do see divergences at times that are regionally and seasonally dependent.

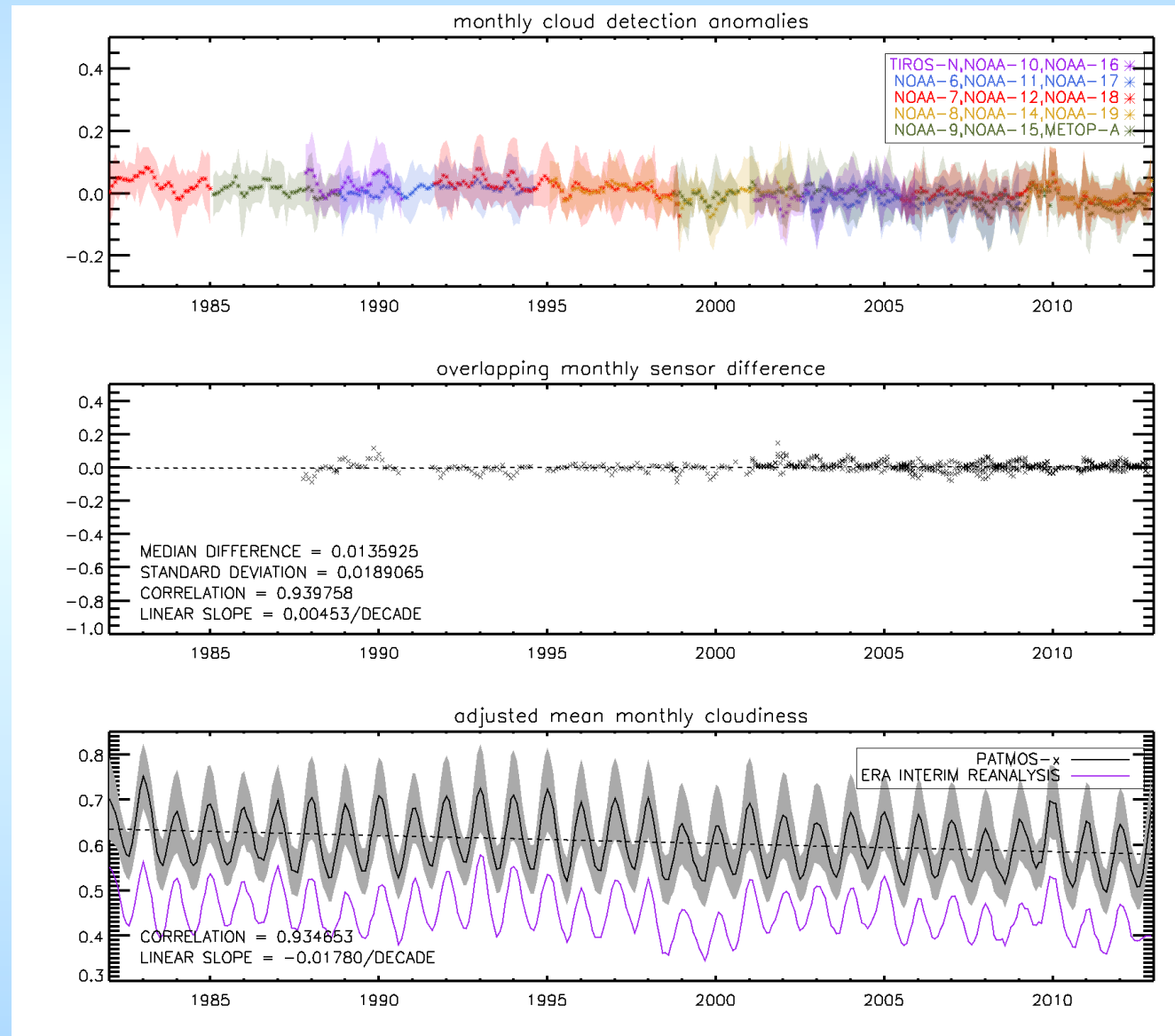
Comparison of PATMOS-x and CM-SAF Cloud Fraction over Poland (1982-2010)



Satellite to Satellite Consistency of PATMOS-x Cloud Products

We derive global AVHRR cloud properties and are charged with delivery of a subset of them as CDRs.

Images to the right show validation of the consistency of cloud detection. The top panel shows the diurnally corrected cloud anomalies by satellite. The middle panel shows the satellite-to-satellite difference. The bottom panel is a comparison against the ERA Interim reanalysis. The area analyzed is the continental United States.



Concerns, Risks and Issues

Issues:

- Daily updates use extrapolated calibration coefficients – periodic redelivery of the most recent data may become necessary as calibration coefficients are updated.
- Users have requested faster download times when large amounts of data are ordered from NCDC.
- Currently we are converting our hdf files to NetCDF Classic 4 format – **we are awaiting confirmation that this meets formatting and metadata requirements of NCDC.**
- AVHRR/1 product data is not of same quality as AVHRR/2&3. (Ch3b noise and data gaps)
- It would be nice to get the Mittaz CDR AVHRR IR techniques implemented into PATMOS-x.

Risks

- Unsure of the progress towards implementing and modifying PATMOS-x code for running at NCDC/CICS.

Uses & Applications

Specific examples of people using AVHRR PATMOS-x Level-2b CDRs.

- PATMOS-x AVHRR data has appeared as the cloud data set used in BAMS State of Climate since 2006.
- PATMOS-x data used in **AMSU FCDR** work (Huan Meng, NOAA/NESDIS)
- PATMOS-x FCDRs used for **NOAA Aerosol CDR** derivation (Tom Zhao, NCDC)
- PATMOS-x FCDR data and methodology provided to **EUMETSAT** for use in CM-SAF cloud and surface reflectance products.
- NREL solar energy climatology** from GOES PATMOS-x Level-2b. NREL serves this to private industry (2005-2012). AVHRR analysis ongoing.
- Michael Cleaver of **USGS** obtained PATMOS-x for vegetation studies.
- Tim Smyth of UK used PATMOS-x reflectance for oceanic biology study.
- Arturo Sanchez, University of Girona, Spain, downloaded PATMOS-x cloud fractions for a Iberian Peninsula climate study.
- WJ Zhao of Nanjing University, China downloaded PATMOS-x cloud fractions for long-term study of climate variability in China.
- Lin Gao at NMSC (China) using PATMOS-x for long-term aerosol over land studies.
- DLR has downloaded PATMOS-x data and is starting their own HRPT CDR.
- Lara Dalmeyer, South Africa – Lake Kariba (Zimbabwe) – cloud studies.
- Jan Cermak, Ruhr-Universität Bochum, PATMOS-x LST.
- JPL also runs PATMOS-x to generate Level-2 version of the CDRs.

Schedule

■ CDR status

- The daily processing of the CDR as well as QA and monitoring is currently running at CIMSS.
- Finalizing version 5.3 code, data and validation.
- We are ready to reprocess the record and deliver (and commence daily updates)
 - We plan to deliver in October or November this year (2013).

■ 1-3 Year Planning Horizon

- A major new calibration effort is being planned using the updated MODIS Collection 6. This may eventually require a redelivery of some portion of the data.
- A new suite of cloud products that include the ingestion of the Menzel HIRS CDR to make a MODIS-like AVHRR+HIRS record is scheduled to become available in the next 2-3 years.